My work has been amongst girls, and the attempts made thus far in teaching scientific method in girls' schools show that such a method will inevitably lead to the development desired by Prof. Armstrong.

Doubtless one of the drawbacks is the difficulty of giving to each member of a large class the opportunity of individual work. I am not sorry, however, to have sometimes laboured under this difficulty myself, as it has brought about the discovery of how much could still be done on the right lines. When necessary I have replaced individual work by a demonstration class, in which the pupils, three or four at a time, have taken it in turns to work in front of the others, the work consisting in the solution of problems such as those suggested in the British Association's report on chemical teaching. The principal results are these: the children take a growing interest in the work, and those who are doubtful how far girls may desire to work with their hands, instead of always sitting still, may be glad to hear that no greater incentive to invention can be given in a demonstration class than the reward of becoming the experimenter for the time being. There is never any lack of suggestion for the next step in the work, and the rapidity with which such work trains the girls to consider the value or defects of any new proposal for the solution of their problem, is sometimes astonishing. In these classes the teacher plays a very small part—at least, apparently—only from time to time directing the suggestions, and giving permission for new work to be started; invention, experiment, meaning of results, and criticism are all undertaken by the children, and the final "discovery" is their own triumph.

I have often been asked by teachers about the discipline of such a class, since experimental work goes so slowly that they think it would be impossible to keep those who are not actually at work attentive. I can only say that the class consists of a group of people genuinely interested in a common object, and it behaves in the way such groups generally do. If at times a girl's enthusiasm so far carries her away that she rushes from her seat to the experimenting table, the class, with a laugh, excuses her, sympathises with her feelings, and is not disturbed thereby.

It seems unquestionable that the result of such work should have a wider reaching effect than the mere knowledge of certain facts in nature, though such knowledge is also obtained. Where children, through their own work, have been led to observe and then to think, the result may fairly claim to be truly educative, and one is often at a loss to understand what support can be found for the still largely-existing method of teaching not science but "useful information."

Another objection often made to teaching scientific method instead of facts, that it takes too much time, I have already answered in this journal. I may perhaps be permitted to repeat that experiment shows the result of elementary training, of the kind described, to have a lasting influence on the rapidity and comprehension with which new subjects are grasped later on. Books, too, which are never put into the hands of beginners, are used with more than ordinary sense at this later stage. I may say that, even from the examination test (which, however, is not always going to be our standard), the results are very favourable. One thing, however, cannot be done by the teaching of scientific method, and that is to prepare for the London Matriculation examination in chemistry in three months—but then, is that altogether to be regretted?

GRACE HEATH.

North London Collegiate School for Girls, November 5.

Italian Scientific Expedition to Monte Rosa.

IN the summer of this year, my assistant Dr. L. Scofone and I stayed a month at the Alp of Lavez in the valley of Gressoney, near the foot of the Indren glacier, at an altitude of 2450 m., not far from the place where the brothers Schlagintweit spent some days in 1851 while engaged in their well-known scientific observations on Monte Rosa.

We purposed to examine, both chemically and bacteriologically, the composition of the waters of that region (inclusive of snow and ice); some of the analyses (ammonia, nitrites, nitrates and organic matter) were made directly on the spot, where we had a small laboratory. To be able to carry the waters to Turin, for further analysis, we had only to evaporate them, and seal the residues in little glass bottles by means of a blowpipe. The detection of germs was made by using agar and gelatine plates enclosed in the well known Petri's glass-boxes; gelatine, agar, pipettes, and other instruments being duly sterilised first in Turin, and then at Lavez, with a good hot air oven. The development of germs was secured by putting the plates in an incubating oven.

We also collected the water of the Indren torrents issuing from the glacier, and measured the amount of suspended matter in the water, which can give an idea of the process of erosion that takes place in the bed of the ice stream.

The results of the various observations will be published in the scientific papers of Turin as soon as the study of the collected material has been completed. It will perhaps interest your readers to know that while the water of the springs, streams and lakes was constantly free from ammonia, there was found a tolerable quantity of it in the snow collected on the summit of the Punta Guifetti or Signal Kuppe, one of the loftiest peaks in the Monte Rosa range, measuring 4539 m. The ice of the Lys Glacier, dug out from the depths of a huge crevasse, also contained ammonia; nitrites and nitrates being absent in every case. Accordingly we found that the water of the Indren stream, during a very hot day, when the melting of the ice was considerable, contained traces of ammonia.

We also found that the ice and snow collected on the various peaks, passes, and snow-fields of the Monte Rosa range, contained a few germs. The number of the species whose germs can thrive at those heights is certainly not large; the usual forms, living in decayed matter and in the intestines, cannot probably endure the condition of temperature, pressure and light of the place.

Turin, October 28. PIERO GIACOSA.

Chinese Beliefs about Caves.

MR. HERBERT SPENCER, in his "Principles of Sociology" (3rd edition, New York, vol. i. p. 207), relates the beliefs in the creation of mankind under the ground or in caverns, current among the Todas in Asia, the Basutos in Africa, and at least one-half of the American tribes. A similar belief I have lately found in a Chinese record. In Li Shih's *Süh Póh-wuh-chì* (written in the 13th cent. A.D., Japanese edition, 1683, tom. ii. p. 3) a quotation from the *Ning-kwóh-lun* runs as follows:—"Primitively there was no Liáu-Kién in Shuh (now Sze Chuen); this tribe emanated from red clay in a cave of Teh-yáng mountain, whence bits of the soil had began to roll out, each roll enlarging them, so that at last thereby was created a couple, who gave birth to many."

In another paragraph Mr. Spencer remarks:—"Stationary descendants of troglodytes think that they return into a subterranean other-world whence they emerged (*ibid.* p. 213). According to this, I would suggest that the same belief, entertained by some aborigines in China, has revived itself among the Taôists, who used to call their paradise the "Cave-Heaven" (Tung-Tièn)—*e.g.* Twan Chìng-Shih describes the "Cave-Heaven" 10,000 *lis* in circumference and 2600 *lis* in height (his "Miscellanies," Japanese edition, 1697, tom. ii. p. 1), and Li Shih enumerates thirty-six caves in the empire, all entitled "Heavens" (*ibid.* tom. i, p. 8).

KUMAGUSU MINAKATA.

15 Blithfield Street, Kensington, W., November 2.

Spots over Dogs' Eyes.

I WOULD have written a note on this subject long ago, had I not failed to see similar spots general amongst wild animals allied to the dog. The spots may, however, be more general than I am aware. The spots are by no means always tan; a black dog will sometimes have them white, and a white dog black. I have a white and tan fox-terrier, in which the spots are very eye-like and jet black; in a brown bull-pug of mine, the spots are also black. These spots are so eye-like, that when the dogs are asleep they seem at first sight to be wide awake.

Has not the human eyebrow, highly developed in some crude races, as in Australians and Ainos, a similar meaning? The eyebrow gives many sleeping persons the appearance of being awake. WORTHINGTON G. SMITH.

Dunstable.

Gravitation.

IN his interesting paper upon the "Mechanical Stretching of Liquids" (*Phil. Trans.* 1892, A, p. 370), Prof. Worthington describes a phenomenon of attraction between bodies immersed

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in a stretched liquid. His explanation is ingenious: that the close contact of the bodies liberates from a denser surface layer, liquid which will go to supply the prevailing demand, and so lower the energy of the stretched liquid.

Whether this be a quite correct explanation or not, does not the experiment suggest the possibility of an analogous phenomenon occurring in a tensile ether in which matter is immersed; giving rise to the effects which we appreciate as gravitational attraction? J. JOLY.

Trinity College, Dublin, November 6.

Homogeneity of Structure the Source of Crystal Symmetry.

To the lucid notice of my paper, "Ueber die geometrischen Eigenschaften homogener starrer Strukturen und ihre Anwendung auf Krystalle," contained in your issue of October 18, it is perhaps desirable to add a remark.

The paper referred to is purely geometrical; it starts with a definition, and not with a supposition. Consequently the various new theories advanced by the writers referred to in the notice receive no support from it.

Homogeneity of structure pure and simple, unaided by any theory as to the nature of matter, leads inevitably to all the varieties of symmetry presented by crystals. It is useless, therefore, to look to the facts as to this symmetry for any light upon the vexed question whether the seat of the symmetry is in the arrangement or in the configuration of the molecules, or, indeed, for any proof of the existence of molecules or separable units. WM. BARLOW.

Muswell Hill.

THE PRESENT STATE OF PHYSIOLOGICAL RESEARCH.

THE following extracts from an article by Prof. Max Verworn, of Jena, on "Modern Physiology," published in the *Monist* for April 1894, seem to be well worth the attention of English biologists. It would be interesting to obtain in the pages of NATURE an expression of opinion from our physiologists as to how far the reproach is true, that "in treading the beaten paths we are making no progress in physiology, and have stood still for years on the same spot." How far is it true that physiologists must revert to the point of view of comparative physiology, or the physiology of the endless variety of lower and simpler forms of life which was that which formerly so fruitfully shaped the research of the great master Johannes Müller? Is it, or is it not, time that the methods of horological physiology were less dominant and gave place to a determined and persistent study of living structure in its varied manifestations other than the frog and the rabbit?

"Psychologically, it is a highly interesting phenomenon, and one of moment in the history of science, that now, almost immediately after the final suppression of the old vitalism by the new development of the natural sciences, we have again arrived at a point which corresponds in the minutest details to the reversion to mystical vitalism which took place after the clear and successful research of the preceding century. As a fact, the parallel between the conditions of the eighteenth century and those of to-day is unmistakable. Now, as then, the physico-chemical method of explaining phenomena of life looks back on a brilliant, almost dazzling sequence of successes; now, as then, the tracing of vital processes to physical and chemical laws has reached a point at which, for many years, with the methods now at our command, no essential progress has been made, where, on the paths hitherto trodden, a boundary line is everywhere distinctly marked; and now, as then, on the horizon of science the ghost of a vital force looms up. It has already taken possession of the minds of serious thinkers in Germany, with the dire prospect of more extensive conquests; and in France, too, it would seem, science is slowly opening its door to this invasion of genuine mysticism.

"To understand this phenomenon psychologically, and to acquaint ourselves with the means of staving off a general reaction into vitalism, it is desirable to examine more carefully the present state of physiology. A review of the productions which appear in our different physiological journals, which will best exhibit the present state and tendency of the science, furnishes an extremely remarkable spectacle. Leaving aside the science of physiological chemistry, which is independently developing with great success, we find, with the exception of a few good contributions to the physiology of the central nervous system, as a rule, only extremely special performances of very limited scope and import, wholly without significance for the greater problems of physiology, whether practical or theoretical, and exhibiting no connection whatever with any well-defined general problem of physiology. In fact, what is called physiology is beginning here and there to degenerate into mere technical child's play. With every new number of our physiological magazines, the unprejudiced observer is gradually gaining the conviction that general problems of physiology no longer exist, but that inquirers, driven to desperation in the struggle for material, have no choice but to hunt up the old dry bones of science, on which they fall with the nervous rapacity of hungry dogs. And in the case of most of the productions, this impression is strengthened by the fact that the results, when once found, are wholly disproportionate to the tremendous expenditure of labour and time which it might be seen beforehand they would require. And yet all the time the great problems of physiology everywhere stare us in the face and seek solution. For, if we regard the problem of physiology as the investigation of the phenomena of life, we are certainly yet very far from the solution of even its most important and most general problems. We need not go to the extreme that Bunge does in his excellent text-book of physiological chemistry, of maintaining that the phenomena of our organism which we have explained mechanically are not genuine vital processes at all, no more than is 'the motion of the leaves and branches of a tree shaken by a storm, or the motion of the pollen which the wind wafts from the male to the female poplar.' But it is certainly no exaggeration to say that what the splendidly-conceived methods of the great masters of physiology since Johannes Müller have explained, are not elementary processes of life, but almost exclusively the crude physical and chemical actions of the human body.

"For what have we attained? We have measured and registered the motions of respiration, the mechanics of the gaseous exchange in the lungs in their minutest details. We know the motions of the heart, the circulation of the blood in the vascular system, nay, even the slightest variations of the pressure of the blood, as produced by the most diverse causes, as accurately as we do the phenomena of hydrodynamics in physics. We know that respiration and the motion of the heart are conditioned by the automatic activity of nervous centres in the brain. But no spirometer, no kymograph, no measuring or registering apparatus can give us the slightest idea of what takes place in the nerve-cells of the brain that condition the beating of the heart and respiration.

"Further, we have investigated the motions of the muscles, their dependence on the most diverse factors, their mechanical powers, their production of heat and electricity, as exhaustively as only the phenomena of the special departments of mechanical physics have hitherto been treated. But of what goes forward in the minute muscle-cells during simple muscular contraction, no myograph, no galvanometer has as yet given us the slightest hint.

"We know also the laws of the excitability of the nervous fibres, of the propagation of irritations, of the direction and velocity of nervous transmission, thanks to the ingenious methods of recent physiology, in all their details. But of what is enacted during these processes in the nerve-fibres and in the ganglion-cell from which it ramifies, no induction-apparatus or multiplicator can give us the least information.

"We know besides, that the heat and electricity produced by the body, and the mechanical energy of muscular work, are the consequence of the transformation of the chemical energy which we have taken into our bodies with our food. But by means of what chemical processes the cells of the individual structures take part in these achievements, the most sensitive thermometer or calorimeter will not disclose, and no thermal pile or graphical apparatus will indicate.

"We might give any number of examples of this kind, but those adduced exhibit distinctly enough the point to be signalised. What we have hitherto attained is this: we have measured, weighed, described, and registered the gross

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